17. (Amended) The method of Claim 16, wherein the micro-actuator is an electrostatic micro-actuator.

18. (Amended) The method of Claim 16, wherein the selecting step includes the step of moving the reflective element by a translation and a rotation.

19. (Amended) The method of Claim 16, wherein the selecting step includes the step of moving the reflective element about a virtual pivot point.

REMARKS

Applicants acknowledge that the final rejection of Claims 1-20 contained in the Office Action mailed February 3, 2003 has been withdrawn in response to the Communication mailed February 18, 2003.

As noted in the Amendment mailed November 15, 2002, the Supplemental Information Disclosure Statement filed October 9, 2001 does not appear to have been considered by the Examiner. A copy of the Supplemental Information Disclosure Statement, as well as a copy of the return postcard from the U.S. Patent and Trademark Office, are enclosed herewith. Applicant requests that the Examiner consider the Supplemental Information Disclosure Statement and acknowledge such consideration in the next Action.

Claims 1-12 and 16-20 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Leckel et al. (U.S. Patent No. 6,404,798) in view of Dhuler et al. (U.S. Patent No. 6,428,173). Claims 13-15 have been similarly rejected over Leckel et al. in view of Dhuler et al., as applied to Claims 1 and 16 above, and further in view of Jerman et al. (U.S. Patent No. 6,329,737). Reconsideration of these claims is respectfully requested.

Leckel et al. disclose a low noise and wide power range laser source. FIG. 1 of Leckel et al. shows in principle a laser source 5 according to certain art documents cited in the background of the invention. In FIG. 1, a laser gain medium or amplifier 10 provides a first facet 20 which is low reflective and a second facet 30 which is high reflective. The first facet 20 emits a laser beam 50 into an external cavity of the laser source 5. A collimating lens 60 collimates the laser beam 50 to a beam splitter 65 splitting the laser beam 50 into a part 50' and a part 67. The part 50' of the laser beam 50 is directed to an optical grating 70 as a wavelength dependent mirror. The optical grating 70" diffracts the incident beam 50' and a wavelength separated beam 50" is directed back towards the beam splitter 65. The angle of the optical grating 70 with respect to the beam 50" depends on the wavelength to be selected. The optical grating 70 together with the facet 30 of the semiconductor amplifier 10 define the optical resonator of the laser source 5. The beam splitter 65 splits up the returning beam 50" into a beam 50'" towards the gain medium 10

and a beam 80. The laser system 5 provides as output signals the laser beams 67 and 80, coupled out respectively from the beam splitter 65. The output beam 80 can be coupled into a fiber 90, e.g., by means of an optical lens 100. Col. 2, lines 6-25. As a further improvement over the laser source 5 of FIG. 1, either in addition to the provision of the output beam 210 or independent thereof, the laser source 200 of FIG. 2 further provides a mirror 270. Col. 5, lines 31-35. Preferably, the mirror 270 is arranged in a Littman-configuration allowing a mode-hop free wavelength tuning of the laser source 200. In the Littman-configuration, as known in the art, planes through the grating 70, the mirror 270, and the facet 30 substantially intersect in a point 290. Col. 5, lines 48-52.

Dhuler et al. disclose a moveable MEMS mirror structure including a thermal actuator and a mirror having a mirrored surface positioned out of plane relative to the underlying microelectronic substrate surface in both non-actuated and actuated positions. The MEMS mirror structure can also include various latching mechanisms that can be used to hold the mirror in a fixed position, even after the thermal actuator is deactivated. Further, MEMS moveable mirror structures may be disposed in an array and individually controlled to serve various high resolution applications, such as optical switching, optical attenuation, or the like. Dhuler et al. state that as those skilled in the art will appreciate, however, the MEMS moveable mirror structures provided therein may be used advantageously in other applications. Col. 5, lines 36-52. The microactuator of FIG. 1 in Dhuler et al. is a thermal arched beam actuator. The thermal arched beam actuator comprises at least two anchors, for example anchor 32 and anchor 33. Each anchor is affixed to the microelectronic substrate to provide support for the thermal arched beam actuator. Further, the thermal arched beam actuator includes at least one arched beam 35 disposed between at least one pair of anchors. Each arched beam extends between a pair of anchors such that the ends of the arched beam are affixed thereto and the arched beam is held in place overlying the microelectronic substrate. Col. 6, lines 55-65. Dhuler et al. further state that any of the microelectromechanical moveable mirror structures according to that invention can be applied to redirect electromagnetic radiation. The term electromagnetic radiation is defined by Dhuler et al. to include but is not limited to light, laser, radio frequency, infrared, or any other type of electromagnetic radiation that can travel along a path, whether visible or not. If a source directs electromagnetic radiation along a path, a moveable microelectromechanical mirror structure can be deployed to intersect and redirect the path of electromagnetic radiation. Col. 17, lines 35-44.

Claim 1, as amended, is patentable by calling for a tunable single mode laser microassembly operable over a range of wavelengths of the type set forth therein having, among other things, an electromechanical micro-actuator coupled to one of the diffractive element and

the reflective element for causing angular movement of such element to permit selection of a single wavelength from the range of wavelengths by altering the optical path of the light.

In rejecting Claim 1 over Leckel et al., the Examiner acknowledges that Leckel et al. disclose a laser configuration that is well-known in the art but do not disclose a micro actuator for providing movement to the mirror to obtain a tunable laser. The Examiner further states that Dhuler et al. disclose in the abstract microelectromechanical structures (MEMS) used for controlling the movement of mirrors and, therefore, that it would have been an obvious at the time the invention was made to combine the moveable microelectromechanical mirror of Dhuler et al. with the laser system of Leckel et al. because it would provide movement to the mirror of Leckel et al. for controlling the retro reflected beam and obtaining a tunable laser.

A proper analysis of the obviousness/nonobviousness of the claimed invention under 35 U.S.C. §103(a) requires consideration of two factors: (1) whether the prior art would have suggested to those of ordinary skill in the art that they should carry out the claimed invention; and (2) whether the prior art would also have revealed that in so carrying out the claimed invention, those of ordinary skill would have a reasonable expectation of success. Both the suggestion and the reasonable expectation of success must be founded in the prior art, not in the applicant's disclosure. In re Sernaker, 217 U.S.P.Q. 1, at 5 (Fed. Cir. 1983); and In re Vaeck, 20 U.S.P.Q.2d 1438, 1442 (CAFC 1991).

In the present case, the rejection of the claims under 35 U.S.C. §103 is in error because Leckel et al. fail to provide the requisite suggestion/motivation to provide a laser assembly of the type called for therein having, among other things, an electromechanical microactuator coupled to one of the diffractive element and the reflective element. The Examiner acknowledges that Leckel et al. fail to disclose a microactuator for providing movement to the mirror to obtain a tunable laser. In addition, however, Leckel et al. fail to disclose any actuator, let alone an actuator coupled to one of the diffractive element and the reflective element.

Similarly, Dhuler et al. do not provide the requisite motivation to add a microactuator to a laser assembly of the type disclosed in Leckel et al. For example, Dhuler et al. do not disclose a laser having a diffractive element as called for in Claim 1. Nor do Dhuler et al. disclose a tunable single mode laser microassembly. Rather, Dhuler et al. merely disclose microelectromechanical structures that include a thermal actuator for substantially linear translation of a mirror. Although Dhuler et al. state that the mirror can be used to redirect electromagnetic radiation, which is stated to include laser, there is no suggestion or disclosure that the Dhuler et al. device is suitable for use in a tunable or other laser for generating laser light.

Even if a microactuator of Dhuler et al. was combined with a device of the type disclosed in Leckel et al., there is no suggestion or disclosure in the prior art that in so carrying out such combination those of ordinary skill would have a reasonable expectation of success. For example, there is no disclosure in Dhuler et al. as to how a microactuator of the type disclosed therein, providing substantially linear movement, could be used for causing angular movement of one of the diffractive element and the reflective element to permit selection of a single wavelength from the range of wavelengths by altering the optical path of the light.

In addition to the foregoing, and as can be appreciated by those skilled in the art, the field of microactuator design is still nascent. Contrary to the belief of the Examiner, it cannot be assumed that any particular actuator configuration can be developed or is physically possible. Hence, there is no reasonable expectation that the inclusion of a microactuator in a device of the type disclosed in Leckel et al. would be successful in producing a tunable single mode laser assembly, let alone a tunable single mode laser microassembly as called for in Claim 1.

In view of the foregoing, the Examiner's rejection of Claim 1 as being obvious over Leckel et al. in view of Dhuler et al. is improper and should be withdrawn. Claim 1 should be found allowable.

Claims 2-12 depend from Claim 1 and are patentable for the same reasons as Claim 1 and by reason of the additional limitations called for therein. Claim 4 is additionally patentable by providing that the displacement of the reflective element comprises an angular displacement. There is certainly no disclosure in Dhuler et al. of a microactuator that provides such displacement, let alone a suggestion as to how such a microactuator could be developed and used to provide a tunable single mode laser microassembly. Claim 4 is additionally patentable by stating that the electromechanical micro-actuator provides sufficient angular movement of such element to permit selection of a single wavelength from a range of wavelengths extending over approximately 40 nanometers. In this regard, bent-beam thermal actuators similar to those of Dhuler et al. are disclosed in Que, et al. (Proc. 12th Int. Conf. Micro Electro Mechanical Systems, pp. 31-36, published January 17, 1999), a copy of which is enclosed herewith. Such reference suggests that single element beam actuators can provide linear travel of about 10 microns. Such travel would be insufficient, and thus unsuitable, for providing sufficient movement of a diffractive element or a reflective element to permit selection of a single wavelength from the range of wavelengths extending over approximately 40 nanometers by altering the optical path of the light. Claim 5 is additionally patentable by providing that the angular movement occurs about a virtual pivot point and Claim 6 is additionally patentable by providing that the angular movement comprises a translation and a rotation. The additional

limitations of Claims 5 and 6 are not suggested or disclosed by the prior art. Claim 12 is additionally patentable by providing that the micro-actuator is a rotatable micro-actuator.

Claim 13 is patentable by calling for a tunable laser comprising source means for providing a light along an optical path with any wavelength selected from a bandwidth of wavelengths, a diffractive element positioned in the optical path and spaced from the source by a first distance to redirect the light, a reflective element positioned in the optical path and spaced from the diffractive element by a second distance to receive the redirected light from the diffractive element and to redirect the light back towards the diffractive element, the light being redirected by the diffractive element back towards the source, and an electrically-driven micro-actuator for selecting the wavelength from the bandwidth of wavelengths by altering the optical path of the light between the diffractive element and the reflective element, the micro-actuator including a substrate and at least one rotary comb drive carried by the substrate.

Contrary to the assertion of the Examiner, and as discussed above, the rejection of Claim 13 under 35 U.S.C. §103 is in error because Leckel et al. fail to provide the requisite suggestion/motivation to provide a laser assembly of the type called for therein having, among other things, an electromechanical microactuator coupled to one of the diffractive element and the reflective element and Dhuler et al. do not provide the requisite motivation to add a microactuator to a laser assembly of the type disclosed in Leckel et al.

The inclusion of Jerman et al. does not remedy such erroneous rejection as there is no suggestion or disclosure in Jerman et al. that the comb drive assemblies disclosed therein would be suitable for use in a thermally actuated microactuator of the type disclosed in Dhuler et al., let alone in a tunable laser of the type called for in Claim 13. In this regard, a comb drive assembly is electrostatically driven, while the microactuator of Dhuler et al. is thermally actuated. Such principles of operation are quite different and do not permit, as appears to be suggested by the Examiner, a comb drive assembly to be substituted into a thermally actuated microactuator to provide a workable device. There is further no suggestion in Jerman et al. that the microactuator thereof would be suitable for use in a tunable laser.

Even if a microactuator of Jerman et al. was combined with a laser assembly of the type disclosed in Leckel et al., there is no suggestion or disclosure in the prior art that in so carrying out such combination those of ordinary skill would have a reasonable expectation of success. In this regard, there is no suggestion or disclosure in Jerman et al. that the microactuator thereof would be suitable for selecting the wavelength from the bandwidth of wavelengths by altering the optical path of the light between the diffractive element and the reflective element. Applicants further reiterate that the field of microactuator design is still nascent and thus it

cannot be assumed that any particular actuator configuration can be developed or is physically possible.

Claims 14-15 depend from Claim 13 and are patentable for the same reasons as Claim 13 and by reason of the additional limitations called for therein.

Claim 16 is patentable for reasons similar to those discussed above with respect to Claim 1 by calling for a method for using a tunable single mode laser microassembly to provide light with any wavelength selected from a range of wavelengths, comprising the steps of providing the light along an optical path, providing a diffractive element in the optical path to diffract the light, providing a reflective element in the optical path to reflect the light and selecting a single wavelength of light by altering the optical path of the light by means of a micro-actuator coupled to the reflective element for causing angular movement of the reflective element.

Claims 17-20 depend from Claim 16 and are patentable for the same reasons as Claim 16 and by reason of the additional limitations called for therein. For example, Claims 18 and 19 are additionally patentable for reasons discussed above with respect to Claims 6 and 5.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with Markings to Show Changes Made."

In view of the foregoing, it is respectfully submitted that the claims of record are allowable and that the application should be passed to issue. Should the Examiner believe that the application is not in a condition for allowance and that a telephone interview would help further prosecution of this case, the Examiner is requested to contact the undersigned attorney at the phone number below.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the claims:

Amend the following claims as indicated:

1. (Four Times Amended) A tunable single mode laser microassembly operable over a range of wavelengths comprising a source for providing a light along an optical path with any wavelength from ~~a~~the range of wavelengths, a diffractive element positioned in the optical path and spaced from the source by a first distance to redirect the light, a reflective element positioned in the optical path and spaced from the diffractive element by a second distance to receive the redirected light from the diffractive element and to redirect the light back towards the diffractive element, the light being redirected by the diffractive element back towards the source, and an electromechanical micro-actuator coupled to one of the diffractive element and the reflective element for ~~selecting~~causing angular movement of such element to permit selection of a single wavelength from the range of wavelengths by altering the optical path of the light.

3. (Thrice Amended) The laser microassembly of Claim 1 wherein the micro-actuator is coupled to the reflective element to ~~displace~~cause angular movement of the reflective element.

4. (Twice Amended) The laser microassembly of Claim 1~~3~~, wherein the ~~displacement comprises an~~electromechanical micro-actuator provides sufficient angular ~~displacement~~movement of such element to permit selection of a single wavelength from a range of wavelengths extending over approximately 40 nanometers.

5. (Twice Amended) The laser microassembly of Claim ~~4~~1, wherein the angular ~~displacement~~movement occurs about a virtual pivot point.

6. (Twice Amended) The laser microassembly of Claim ~~4~~1, wherein the ~~displacement~~angular movement comprises a translation and a rotation.

7. (Thrice Amended) The laser microassembly of Claim 1, wherein the ~~miro-actuator~~micro-actuator comprises a micro-machined actuator.

12. (Twice Amended) The laser microassembly of Claim 10, wherein the ~~source comprises a Fabry-Perot laser~~micro-actuator is a rotatable micro-actuator.

13. (Twice Amended) A tunable laser comprising source means for providing a light along an optical path with any wavelength selected from a bandwidth of wavelengths, a

diffractive element positioned in the optical path and spaced from the source by a first distance to redirect the light, a reflective element positioned in the optical path and spaced from the diffractive element by a second distance to receive the redirected light from the diffractive element and to redirect the light back towards the diffractive element, the light being redirected by the diffractive element back towards the source, and an electrically-driven micro-actuator for selecting the wavelength from the bandwidth of wavelengths by altering the optical path of the light between the diffractive element and the reflective element, the micro-actuator including a substrate and at least one rotary comb drive carried by the substrate.

16. (Four Times Amended) A method for using a tunable single mode laser microassembly to provide light with any wavelength selected from a range of wavelengths, comprising the steps of providing the light along an optical path, providing a diffractive element in the optical path to diffract the light, providing a reflective element in the optical path to reflect the light and selecting a single wavelength of light ~~from the range of wavelengths~~ by altering the optical path ~~through displacement~~ of the light by means of a micro-actuator coupled to the reflective element for causing angular movement of the reflective element.

17. (Amended) The method of Claim 16, ~~further comprising the step of displacing the reflective element with~~wherein the micro-actuator ~~to alter the optical path~~is an electrostatic micro-actuator.

18. (Amended) The method of Claim 16, ~~further comprising~~wherein the selecting step includes the step of ~~displacing~~moving the reflective element by a translation and a rotation.

19. (Amended) The method of Claim 16, ~~further comprising~~wherein the selecting step includes the step of ~~displacing~~moving the ~~micro-actuator~~reflective element about a virtual pivot point.